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CREDIT CONSTRAINTS IN EDUCATION: EVIDENCE FROM INTERNATIONAL DATA

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This paper tests empirically the credit-constraints thesis by using cross-country data on secondary and higher-education enrolment rates. Contrary to some previous works in this direction, we find several pieces of evidence that support the importance of such a thesis. First, controlling for the effects of both economic development and educational inequality, we find that school enrolments are negatively correlated with income inequality and positively correlated with financial-market development. Second, these correlations are robust to the specific country-effects, the composition of the sample of countries, and the inclusion of public education expenditures. Finally, public education expenditures are significantly correlated with school enrolment ratios. Distinguishing developed countries from developing ones reveals that the effects of both social and material factors are larger in rich countries than in poor ones. Our estimation results also show that the way public expenditures are allocated across educational levels affects enrolment ratios in higher educational stages. Specifically, countries where expenditure allocations are biased in favour of the advanced stages of education at the expense of the basic levels also experience low enrolment ratios in the higher levels of education.

JEL classification codes: H52, I21, O15, O16
Key words: borrowing constraints, educational inequality, education expenditures, empirical estimations

I. Introduction

Recent micro-economic literature established that children from rich families invest more in education than children from poor ones. For instance, based on 35 developing countries, Filmer and Pritchett (1998) found that the bulk of the deficit from universal enrolment up to primary comes from the poor. Using American data, Ellwood and Kane (2000) found that students in the richest quarter of the income distribution were 26 percent more likely to enrol in post-secondary schooling than students in the poorest quarter. There are, in theory, two —not necessarily mutually exclusive— interpretations of such intergenerational correlation.

The first interpretation focuses on the credit-constraints argument, in which

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students from poor families may be prevented from investing in higher levels of education, as they are borrowing-constrained. Indeed, if credit-constraints are binding, then youths from families with fewer financial resources face a higher implicit schooling cost.

The second interpretation emphasizes the role of the family social background—namely, parents' education—as it is associated with higher family incomes. Because parents' higher incomes are generally associated with parents' higher education levels, children of wealthy parents also are better able to access higher educational levels. In fact, children of better-educated parents may inherit the abilities, personalities, and preferences that led to the higher educational achievement of their parents.[1]

On the micro-empirical level, the issue of the relative importance of the two arguments is still unresolved. Indeed, one set of studies finds that the effect of parents' income on children's school attendance is insignificant, compared to that of parents' education levels, and it concludes for the lack of importance of the borrowing-constraint argument vis-à-vis the social-factors argument.[2] For instance, Ellwood and Kane (2000) find that the enrolment gap between the poorest and richest quartile in the United States declined from 26 percent to 9 percent, once controlling for the student's cognitive test scores and parents' education. Cameron and Heckman (1999) and Carneiro and Heckman (2002) show that after controlling for ability, the family income/college enrolment relationship is weak and statistically insignificant in the United States, and that responses to tuition are uniform across income groups. Ability and parents' education, however, are found to be more important, even though a group of people (at most, 8 percent of the population) is seen to be facing credit-constraints that affect their post-secondary schooling. Moreover, Keane and Wolpin (2001) stress that liquidity constraints are tight but have little effect on school attendance decisions in the United States. Credit-constraints are found to have their primary effects on other choices made by youths; that is, the relaxation of borrowing-constraints induces students to work less —while studying— and consume more, but does little to affect attendance

[1] We refer the reader to the studies by Becker (1964), Boudon (1973), Bourdieu and Passeron (1970), Glomm (1997), and Birdsall (1999) for a more extensive literature on the intergenerational transmission of education.

[2] Note that some recent studies pointed out that the positive relationship between parents' education and children's schooling is found not to be robust to controls for unmeasured, intergenerationally-correlated endowments. These studies include Behrman and Rosenzweig (2002) and Black et al. (2005).

decisions. Controlling for parents' background variables and children's ability, Shea (2000) finds a significant effect of parents' income on children's schooling. Using instrumental variables, however, this effect comes out insignificant.

Another set of studies establishes a positive correlation between public expenditures and school attainment and greater tuition sensitivity of enrolments for the poor, which provides support for the financial-constraints assessment. For example, Dynarski (1999) finds a significantly large impact of government financial aid on the college attendance of middle- and upper-income youth in the state of Georgia. Furthermore, Kane (1994) argues that the sensitivity of college enrolment to tuition fees is greater for students from poorer families. Finally, Ellwood and Kane (2000) find that differences in state tuition and grant programs result in differences in terms of children's enrolments in the United States.

We use, throughout this study, cross-country data on school enrolments to test the relevance of the borrowing-constraints argument, while controlling for the effects of social factors and public expenditures on education. Studying this issue from an international point of view may help understand whether the result of the lack of importance of the role of borrowing constraints in educational investment is specific to the United States (or more generally, to developed countries), or may be extended to developing countries.

On the macro-level side, previous empirical works, including De Gregorio (1996), Li, Squire and Zou (1998), Flug et al. (1998), Checchi (2000) and Clarke et al. (2003) have emphasised the role of credit-constraints but are subject to some insufficiencies.

The first insufficiency stems from the fact that these studies usually interpret the negative estimated coefficient upon the income inequality variable in the regression of human capital investment as evidence that supports the borrowing-constraint theory. These studies, however, do not control for the effect of the differences in social factors. Omitting this effect would bias upward the effect of income inequality and would weaken the robustness of the credit-constraint hypothesis.

Second, these studies do not test for the robustness of the borrowing-constraint argument to the composition of the sample of countries. Flug et al. (1998) is an exception, because it demonstrates the importance of this argument in both poor and industrialised countries. However, as this study does not control for the effect of the distribution of social factors on school enrolment, the robustness of this argument should be re-examined.

Finally, these studies use an aggregate proxy for public education expenditures

in the regression of school enrolment rates, where the most frequently used proxy is the ratio of total expenditures on education to GDP. Most of these works find insignificant correlation between these two variables.[3] This may arise simply because this proxy is inappropriate in determining the impact of expenditures on schooling investments.

In this analysis, we disaggregate public education expenditures into expenditures devoted to the primary, the secondary, and the tertiary school levels. This disaggregation allows us to better understand the mechanisms through which the impact of expenditures transmits to school enrolments, and to offer policy guidance in terms of the allocation of expenditures across the various school levels.

The analysis pursued in this paper should be seen as complementary to the studies stressed above, as it attempts to shed more light on the question of the relevance of the credit-constraints hypothesis, its robustness, and the contribution of education provision policy in closing cross-country schooling gaps.

The remainder of the paper is organized as follows: Section II presents the data and estimation methodology. Section III presents the basic results and tests the robustness of the credit-constraints thesis. Section IV examines the impact of public education expenditures in their disaggregated form on school enrolments. Section V evaluates the relative contributions of all these variables in the enrolment gaps between the Sub-Saharan African region and Latin American countries, on one hand, and the OECD countries, on the other. Section VI concludes.

II. Data and estimation methodology

Throughout this study, we use both gross secondary and tertiary enrolment ratios from 1970 to 2000 as our measures of investment in human capital.[4] These data are

[3] For instance, De Gregorio (1996) finds that the ratio of public education expenditures over GDP has a positive but non-significant effect on tertiary school enrolment ratio. Flug et al (1998) find that this effect is insignificant in the case of the secondary school enrolment ratio. Checchi (2000) shows that this effect is significantly positive in the tertiary enrolment case, and significantly negative in the secondary case. The low association of the total public expenditures on education and education attainments is also documented in Gupta et al. (1997) and Gupta et al. (2002) for the case of African countries, and Clements (1997) and Birdsall (1999) for the case of Latin American countries.

[4] Gross secondary (tertiary) enrolment ratio is defined as the total enrolment of students of all ages in secondary (tertiary) school as a proportion of the total population of the pertinent age group. These ratios may exceed 100 percent because some students are older than the corresponding age group.

extracted from the UNESCO database. In order to test for the liquidity-constraint thesis, we experiment with two explanatory variables.

The first variable is *Gini*, the Gini index of incomes, which should proxy for the degree of the collaterable asset inequality.[5] This index is taken from the Deininger and Squire data set (1996). This data-set promises to be of higher quality and broader coverage than any other available data set on income distribution. We include only observations labelled "accepted", which are of higher quality. These observations have to meet three criteria: national coverage of the population, comprehensive coverage of the income source, and comprehensive method of calculation. The definition varies across countries: inequality can be measured in terms of gross or net income or in terms of expenditures, and it can be per capita or per household. Because variation in definitions can affect the international comparability of the data, we include in our regressions controls for different definitions.

Our second variable is *CR*, a proxy of the extent of credit accessibility. Beck, Demirgüç-Kunt, and Levine (1999) constructed data on total credits to households from the banking system over GDP for a large number of countries. This measure may proxy for the development of the banking system, and, at the same time, for the ability of households to obtain credit. The higher it is, the less severe is the borrowing constraint.

One may argue that this proxy is not informative with regard to the real extent of borrowing constraints in the developed countries, where households have the possibility to borrow from other financial and non-financial institutions. Nevertheless, the existence of such a possibility does not imply that households in the developed countries are not credit-constrained, as some financial guarantees also are necessary in order to borrow from these institutions. Therefore, it is likely that poor individuals who are constrained in the banking system are also those who are prevented from borrowing outside this system. This fact justifies the use of our proxy of the borrowing constraint in both the developing and developed countries. Furthermore, our proxy describes the magnitude of borrowing constraints with more precision than monetary aggregate ratios, like M2/GDP or M3/GDP often employed in the literature.[6]

[5] As far as data on distribution are concerned, ideally we need data on the distribution of wealth, which are hard to find. Some data compiled by Alesina and Rodrik (1994) on the distribution of land ownership in 1960 for some countries are available, which is the closest we can get to the distribution of wealth.

[6] See Li, Squire and Zou (1998) and Flug et al. (1998).

For the test of the family social-background factors, we use *GiniEdu*, the Gini index of education over the period 1970-2000, as a proxy for the inequality in the distribution of parents' education. We compute this index using the Barro and Lee database (2000) on the distribution of the population with more than 25 years across the different school levels. Details of the computations are presented in the Appendix.

Based on the above considerations, we begin our tests by estimating the baseline equation given below:

$$S = \beta_1 + \beta_2 \log(y_{70}) + \beta_3 GiniEdu + \beta_4 Gini + \beta_5 CR + \beta_{6j} D_j \text{ ,} \quad (1)$$

where S is the secondary (or tertiary) gross enrolment ratio in percentage; $\log(y_{70})$ is the logarithm of per-capita income in 1970 expressed in PPP at constant prices. This variable is extracted from the Penn World Tables 6.1 (2002); *GiniEdu* is the Gini index of education in percentage; *Gini* denotes the Gini coefficient of incomes in percentage; *CR* is the ratio of credits to households from the banking system over GDP in percentage; D_j (j=1,2,3) denote dummies associated with the different definitions of the *Gini* index of incomes, with D_1= incomes versus expenditures, D_2= individual versus household, and D_3= gross versus net.

Sign expectations are as follows. Enrolment rates are likely to be higher in rich countries ($\beta_2 > 0$). Including this variable in the school enrolment regression is crucial for distinguishing the wealth effect from the banking sector development effect. The higher the inequality in the distribution of parental education, the lower is the percentage of children who are demonstrably able to achieve the primary school level and to attain the secondary and higher levels ($\beta_3 < 0$). Income inequality may limit the access to education when financial markets are imperfect ($\beta_4 < 0$). The more developed a banking system, the less binding the borrowing-constraint and the higher the participation rate in the higher stages of education ($\beta_5 > 0$).

Our sample consists of unbalanced data from 19 OECD countries and 67 developing countries (hereafter, DCs). Individual data by country for the year 2000, with averages for the OECD and DCs for the years 1970 and 2000, are presented in the Appendix. The data show that the secondary and the tertiary school enrolment ratios are at least twice as high in the OECD countries as in the DCs in 1970 and 2000. The OECD countries also have much lower Gini indexes of both income and education than the DCs do. The ratio of credits to GDP is, on the contrary, by far higher in the OECD countries than in the DCs, with respectively ratios of 62 percent and 26 percent in 2000 in these sub-samples.

The regression of the baseline equation is run using both cross-section and panel-data procedures. The latter allows controlling for the country-specific effects. In the case of cross-section estimation, we use the data averaged over the period 1970-2000. In the panel estimation case, data are averaged over five-year periods for two reasons. First, data on Gini coefficients of income are limited in time. By using five-year averages, we achieve a more balanced panel data-set. Second, the data on Gini coefficients of education are available only over quinquennial periods.

In the case of cross-section regressions, equation (1) can be estimated by ordinary least squares (OLS), unless the variance of the error term is heteroscedastic. We test for the potential presence of heteroscedasticity by using the Breusch-Pagan/Cook-Weisberg test. If heteroscedasticity is detected, standard errors are estimated using White's procedure (in order to obtain robust standard errors). The Breusch-Pagan/Cook-Weisberg test is based on the null hypothesis that the variance is constant. Therefore, when the probability is large (> 5 %), we accept the null hypothesis of constant variance.

In the case of panel-data regressions, the generalised least squares (GLS) estimator is the most efficient, provided that the Hausman test accepts the null hypothesis of no correlation between the specific effects and the regressors. This test compares the estimation results of fixed and random effects models. Hausman (1978) shows that when the regressors are exogenous, both the Within and the GLS estimators are consistent. Nevertheless, under the endogeneity hypothesis, the Within estimator is consistent, but not the GLS. Hence, with the null hypothesis of exogeneity, the two estimators provide similar results and the differential statistic is low (and the probability is large (> 5 %)).

We provide the results of the tests for the homoscedasticity and exogeneity hypotheses at the bottom of each table that contains the estimation results.

III. The estimation results

The estimation results of equation (1) are presented in Table 1 for both the secondary and the higher education enrolment rates. Overall, the variables on which we focus in this section account for more than 80 percent and 55 percent of the cross-country differences, respectively, in the secondary and tertiary enrolment rates. Two major results emerge from these estimates.

First, controlling for a country's economic-development and educational inequality, we find that both income inequality and the development of the credit-markets are highly significant in explaining the international variance in school

enrolment ratios. This result is evident in both cases of secondary and higher education enrolment ratios, and tends to contrast with the conclusion of Cameron and Heckman (1999) and Carneiro and Heckman (2002), which stresses the insignificant effects of the financial factors in educational attendance.

Second, both cross-section and panel-data estimations show decreasing marginal effects of social and financial factors with respect to the schooling level. To provide a quantitative appreciation, let's consider the cross-section results. On average, the impact of a one standard deviation increase in the Gini index of education (*GiniEdu*) reduces the secondary enrolment rate by about 17 percent and the higher education enrolment rate by only 7 percent. On the other hand, a one standard deviation increase in the Gini index of incomes (*Gini*) translates into a reduction of 6 percent in the secondary enrolment ratio and a reduction of about 3.5 percent in the tertiary enrolment ratio. With regard to the effect of the borrowing constraint, we find that a one standard deviation increase in the degree of accessibility to credits (*CR*) is associated with an increase of about 4 percent in the secondary enrolment ratio and of 1.2 percent in the tertiary enrolment ratio.

These results may be understood as follows. First, the decreasing marginal effect of education inequality is directly due to the decreasing marginal impact of the parental education on children's school attendance. Indeed, one may argue that social background factors that are present from birth through adolescence mainly produce the ability needed to participate in secondary education. Their marginal effect is, however, diminished during the higher stages of education.

Second, the marginal decrease in the effects associated with income inequality and the extent of credit accessibility arises because the degree of heterogeneity in students' income-classes declines with respect to the school level. Students who have succeeded in enrolling in the secondary level are more likely to be those of relatively wealthy parents. Therefore, additional financial facilities to those students would have only a low-marginal impact on enrolments at the tertiary education level. By contrast, the marginal effect of such facilities should be higher in the case of secondary enrolments, as enrolled students (coming from the primary level) come from more heterogeneous income classes.

Notice that this result is consistent with the study of Checchi (2000), in which the marginal effect of income inequality on enrolments is higher in the secondary than in the tertiary level. In addition, De Gregorio (1996) points out that the secondary school enrolment ratios are the most affected by the degree of borrowing constraints. Nevertheless, those studies have not offered any explanation for these results.

Inequalities in income and education, as well as the extent of financial-market

Table 1. Determinants of gross secondary and higher education enrolment rates, 1970-2000

Variables	Secondary education		Higher education	
	Cross-section	Panel-data	Cross-section	Panel-data
Constant	93.02	5.241	15.23	7.49
	(13.9)	(0.44)	(1.13)	(5.51)
log (y_{70})*	3.15	11.06	4.115	7.231
	(2.44)	(9.35)	(2.35)	(6.25)
GiniEdu	-0.903	-0.521	-0.381	-0.422
	(-9.53)	(-4.66)	(-3.63)	(-5.12)
Gini	-0.661	-0.562	-0.398	-0.313
	(-3.50)	(-4.62)	(-1.94)	(-2.13)
CR	0.218	0.121	0.128	0.272
	(2.63)	(2.33)	(1.35)	(6.02)
D_1: income or	3.704	1.015	5.218	0.825
expenditure	(0.7)	(0.37)	(1.33)	(0.24)
D_2: individual or	-8.391	-0.054	-5.404	0.103
household	(-2.33)	(-0.03)	(-1.13)	(0.04)
D_3: gross	-4.748	1.435	4.253	3.732
or net	(-1.10)	-0.62	-0.87	-1.13
No. observations	72	287	71	284
Method	OLS	Fixed effects	White's procedure	Random effects
R^2	0.869	0.831	0.621	0.515
B-Pagan χ^2(.)	0.02		12.39	
Pr > χ^2	0.892		0.000	
Hausman χ^2(.)		16.22		11.26
Pr > χ^2		0.012		0.081

Note: t-statistics are in parenthesis; * in the case of panel- data estimates, log (y) is used instead of log (y_{70}).

access, could have different effects on enrolments, depending on the level of income in an economy. In order to check this, we split our sample into high- and low-income countries by considering the per-capita income of US$8000 (Purchasing Power Parity terms) in 2000 as the divisor income.[7] The regression results for each subgroup of countries are given in Table 2.

They confirm that the key variables of the model remain highly significant in all the specifications and have quite different effect magnitudes across the two sub-

[7] In 1999, the World Bank defines high-income countries as countries whose GNP per-capita was $9266 or more in 1999. This group includes both developed countries and high-income developing countries.

Table 2. Determinants of gross secondary and higher education enrolment rates, 1970- 2000

Variables	Per-capita income < US$ 8000 (PPP)		Per-capita income > US$ 8000 (PPP)	
	Secondary	Tertiary	Secondary	Tertiary
Constant	106.5	25.57	123.2	91.63
	(9.83)	(3.66)	(11.2)	(3.13)
GiniEdu	-0.813	-0.212	-1.140	-0.773
	(-6.84)	(-2.77)	(-9.1)	(-2.31)
Gini	-0.629	-0.242	-0.876	-1.514
	(-3.28)	(-1.97)	(-3.43)	(-2.22)
CR	0.137	0.113	0.212	0.143
	(1.93)	(1.45)	(2.11)	(1.55)
D_1: income or	-6.458	-0.585	18.30	4.881
expenditure	(-0.99)	(-0.14)	(2.82)	(0.28)
D_2: individual or	-0.754	-0.843	-3.923	2.314
household	(-0.15)	(-0.27)	(-1.18)	(0.26)
D_3: gross	5.957	7.732	-7.344	10.43
or net	(1.02)	(2.06)	(-2.38)	(1.27)
No. countries	54	53	18	18
R^2	0.790	0.590	0.957	0.704
B-Pagan χ^2(.)	0.91	0.20	1.30	3.59
Pr > χ^2	0.339	0.656	0.253	0.058

Note: t-statistics are in parenthesis; estimations are run using OLS.

samples. The surprising result is that our key variables have greater impact in wealthy countries than in poor ones. This implies that policies that aim to alleviate inequalities in income and education or to facilitate the access of households to the credit market are likely to be more effective in fostering education enrolments in wealthy countries. This result seems surprising in light of the widely held conventional wisdom along which these policies should be especially effective in poor countries, where income and education inequalities are high and the financial market is less developed. How can we thus explain this result?

A higher degree of income inequality is generally associated with a larger fraction of the population that is prevented from borrowing to invest in education. In a poor economy, income inequality tends to be high, and therefore, increases in the amount of credits to households should benefit only a small fraction of the population. This fraction should be larger in a wealthy country, where income inequality is relatively low (i.e., where the fraction of the population which is able to borrow is relatively high). Similarly, because inequalities in incomes and education

are higher in low-income countries than in wealthy countries, their marginal impact on enrolments appear lower in the first group of countries.

IV. The effects of public education expenditures

The previous section has established the robustness of both financial and social-factors arguments to the specific country effects and to the sample composition of countries. In this section, we test the robustness of these arguments to the inclusion of the supply-side variables; namely, public education expenditures. Education expenditures may positively affect human capital investment by lowering the cost of education that parents have to pay for their children (the liquidity effect), or by improving the quality of education received by students (the quality effect). These two effects raise the probability of children's participation in higher levels of education or in achieving these levels.

Notice that contrary to theoretical studies that have assumed that more financial education resources translate into better education quality, the empirical tests of such a relationship are not conclusive. For instance, Ehrenberg and Brewer (1995) show that measurable school input has little impact on student achievement, and Hoxby (1998) finds no evidence that smaller classes have a positive effect on test scores. Furthermore, Hanushek and Somers (1999) find no significant association between education spending and student performance in the United States (as measured by test scores).

On the other hand, Betts (1995), Goldhaber and Brewer (1997), and Eide and Showalter (1998) argue that teacher qualifications, smaller classes, and spending funds on computers have a positive impact on student achievement. In addition, Card and Abigail (2002) point out that changes in spending inequality in the U.S. can affect the gap in test scores among different social-background groups. Furthermore, Barro and Lee (1997) stress that family input and school resources are closely related to students' performance, as measured by internationally comparable test scores, repetition rates, and dropout rates. Dearden, Ferri and Meghir (2000) demonstrate that the pupil/teacher ratio has, in the UK, a positive impact on women's wages. Finally, Bedard and Brown (2000) find teaching expenditures and classroom resources (versus administrative resources) have a positive and significant effect on students' test scores in California.

Testing the strength of the relationship between educational expenditures and the quality of education goes beyond the scope of this analysis. But, by studying the effects of public expenditures in their disaggregated form, we are able to provide evidence that shows that this relationship is strong.

As has been stressed in the introduction of this study, macroeconomic studies often tend to focus on the ratio of total expenditures on education over GDP to display the impact of government expenses on school enrolments. But in most of cases, the effect is found to be insignificant. There are at least two major drawbacks in using education expenditures in their aggregated form. The first one is that this form is unable to provide any policy recommendation regarding the allocation of expenditures across the levels of schooling. The second one is that it offers no information on the channels through which expenditures affect schooling decisions. More precisely, the ratio of public education expenditures over GDP cannot distinguish between the liquidity and the quality effects associated with education expenditures.

This distinction has a crucial importance in view of the hierarchic feature of educational investment. For instance, improving the quality of education at the primary level should translate into a higher participation rate in the secondary level. Similarly, the education quality received at the secondary level should affect enrolment rates at the higher level. Thereby, under-investment in a given schooling level may be associated not only with low expenditures devoted to this relevant level, but also to those allocated to the previous ones. One should therefore analyse the effects of public education expenditures in a more disaggregated way in order to better understand the relationship between these expenditures and school enrolments.

Internationally comparable data on public expenditures by educational stage are not available. Our study remedies this deficiency by constructing data on annual per-student public education-expenditures at the primary, secondary, and tertiary levels, expressed in PPP (Purchasing Power Parity) terms. We use data on national public expenditures and total enrolments by school level from the UNESCO database (2003), and data on PPP from the World Penn Tables 6.1 (2002) in order to convert the national measures of per-student expenditures into a real one that is internationally comparable.

The statistics shown in the Tables A1 and A2 in the Appendix show that OECD countries allocate higher per-student expenditures at all levels of schooling than DCs do. In addition, the gaps in per-student expenditures across the school levels are by far higher in the DCs than in the OECD countries. Indeed, the average ratio of tertiary to primary per-student expenditures evolves from around 10 in 1970 to 4.6 in 2000 in the DCs against only a ratio of 3.2 and 1.6 in respectively 1970 and 2000 for the OECD countries.

Different figures of expenditure allocation are likely to have different impacts

on enrolments in the secondary and higher education levels. Specifically, an allocation of public resources biased in favour of higher stages of schooling and against the lower stages may not be effective in fostering enrolments in the higher stages because of the low quality of education received at the lower educational stages. More generally, the impact of different allocations on enrolment ratios at the secondary and higher education levels depends on the "liquidity" and "quality" effects associated with education expenditures.

The partial correlations in Table 3 show a low association between school enrolment ratios and public expenditures, as measured by the ratio of total public education expenses over GDP (τ): A correlation of 0.06 and 0.09, respectively, for the secondary and the tertiary levels. This result suggests that such a ratio may not be appropriate in estimating the effects of expenditures on enrolments.

There is evidence, however, of a higher correlation between school enrolments, and per-student public expenditures allocated to these levels and to the previous ones. For instance, there is a positive correlation between the secondary enrolment ratio and per-student expenditures devoted to both secondary and primary levels. Furthermore, high enrolment ratios at the higher education level tend to be associated with higher per-student public expenditures allocated to this level and toward the primary and the secondary levels as well.

Table 3. Public education expenditures and schooling enrolment rates: partial correlation

No. obs.= 287	*Secondary*	τ	log (Exp_{prim})	log (Exp_{sec})	
Secondary	1				
τ	0.063	1			
log (Exp_{prim})	0.182	0.543	1		
log (Exp_{sec})	0.288	0.611	0.811	1	
No. obs.=284	*Higher*	τ	log (Exp_{prim})	log (Exp_{sec})	log (Exp_{ter})
Higher	1				
τ	0.091	1			
log (Exp_{prim})	0.202	0.631	1		
log (Exp_{sec})	0.177	0.729	0.807	1	
log (Exp_{ter})	0.195	0.625	0.566	0.775	1

Notes: *Secondary* = secondary enrolment rate; *Higher* = higher enrolment rate; τ= ratio of total public expenditures on education over GDP; Exp_{prim} = per-student public expenditures at the primary level; Exp_{sec} = per-student public expenditures at the secondary level; Exp_{ter} = per-student public expenditures at the higher education level; log = the logarithmic form.

Finally, we notice that partial correlations among per-student expenditures at the different levels are fairly high suggesting that including more than one level of expenditure in the regression of school enrolments can introduce biases into the estimations. We therefore re-estimate equation (1) by including the per-student expenditures at the different levels separately. This specification may, however, suffer from an endogeneity problem that arises from possible simultaneity effects between enrolment ratios and expenditure variables.

For this reason, we re-run the same regressions using, in the case of cross-section estimations, average enrolment ratios in the period 1985-2000 as the dependent variables and past expenditures averaged over the 1970-1985 period as instruments for the expenditure variables. In the case of panel-data estimations with fixed effects, lagged values of expenditures are used as instruments for the expenditure variables.

The estimation results are reported in Tables 4 and 5 for the secondary and the higher education levels, respectively. We shall first of all underline that cross-country and panel-data specifications show the same qualitative result; namely, the robustness of the impact associated with the social and financial factors to the inclusion of the expenditure variables. Two other interesting results shown in these tables concern the magnitude of the effects of education expenditures. First, the estimations show a positive coefficient for the effect of the ratio of total public expenditures over GDP in all the specifications and for the two levels of education. But as expected, this effect is statistically insignificant in all the cases. Second, the estimations show more significant coefficients on per-student expenditures $\log(Exp_t)$ allocated across the various school levels. This is especially evident when estimations are run using the 2SLS technique.

Table 6 below summarises the effects of different types of public education expenditures on enrolment ratios. The results in this table are unequivocal. First, as long as the coefficients on the expenditure variables are statistically significant, our argument for the "liquidity" and "quality" channels associated with the effects of public expenditures seem to be well supported by the data.

In fact, the liquidity effect is expressed by the positive correlation between the enrolment ratio at the secondary level and the expenditures allocated to this level, and also by the positive impact of the expenditures received at the tertiary level on the enrolment ratio at this same level. The quality improvement effect is associated with the positive impact of primary expenditures on the secondary enrolment ratios, and with the positive impact of both primary and secondary expenditures on the ratios of higher education enrolments.

Table 4. Determinants of gross secondary enrolment rate, 1970-2000

Variables	OLS			2SLS					
	Cross-section (a)			Cross-section (b)			Panel-data with fixed-effects (c)		
Constant	95.58	95.81	96.77	114.1	101.4	110.9	29.05	32.07	38.60
	(7.87)	(6.97)	(7.21)	(6.07	(7.82)	(8.43)	(2.24)	(5.28)	(2.80)
log (y_{70})*	2.668	2.335	1.527	1.335	1.299	1.012	9.933	8.971	7.591
	(1.87)	(1.26)	(0.82)	(0.69)	(0.70)	(0.78)	(7.08)	(8.06)	(3.91)
GiniEdu	- 0.904	- 0.908	- 0.913	- 0.945	- 0.896	- 0.920	- 0.722	- 0.672	- 0.670
	(- 10.96)	(- 9.58)	(- 10.2)	(- 7.99)	(- 9.80)	(- 10.4)	(- 9.78)	(- 10.4)	(- 6.04)
Gini	- 0.614	- 0.599	- 0.591	- 0.740	- 0.695	- 0.626	- 0.515	- 0.757	- 0.764
	(- 3.70)	(- 2.96)	(- 3.10)	(- 3.17)	(- 3.61)	(- 3.47)	(- 4.73)	(- 8.32)	(- 4.77)
CR	0.223	0.212	0.214	0.220	0.179	0.270	0.185	0.136	0.197
	(3.10)	(2.44)	(2.50)	(2.09)	(2.18)	(2.73)	(3.70)	(2.24)	(2.63)
τ	0.042			0.698			0.132		
	(0.04)			(0.43)			(0.18)		
log (Exp_{sec})		0.802			2.343			2.501	
		(1.16)			(1.90)			(1.97)	
log (Exp_{prim})			1.090			1.843			1.633
			(0.72)			(1.85)			(1.86)
D_1: income or	3.906	4.410	4.227	7.069	4.197	2.718	0.671	-12.80	6.854
expenditure	(0.85)	(0.88)	(0.86)	(1.07)	(0.85)	(0.57)	(0.19)	(- 1.40)	(1.52)
D_2: individual or	- 9.768	- 10.64	- 10.06	- 5.507	- 8.546	- 5.441	- 3.913	10.97	- 2.195
household	(- 2.78)	(- 2.79)	(- 2.76)	(- 1.21)	(- 2.43)	(- 1.28)	(- 1.90)	(2.54)	(- 5.02)
D_3: gross	- 4.305	- 4.318	- 3.728	- 3.491	- 1.235	- 0.163	- 4.826	18.99	- 0.602
or net	(- 1.15)	(- 0.94)	(- 0.83)	(- 0.72)	(- 0.31)	(- 0.04)	(- 1.82)	(2.26)	(- 1.16)
No. observations	70	70	70	68	68	68	145	144	145
R^2	0.900	0.891	0.893	0.829	0.910	0.921	0.878	0.971	0.981

Notes: t-statistics in parenthesis; (a) Average secondary enrolment ratios are computed over 1970-2000 period. Regressions are run using robust estimations. Breusch-Pagan χ^2(.) equals 8.33, 6.55, and 4.45, with Pr > χ^2 equal to 0.00, 0.01, and 0.03; (b) Enrolment rates are averaged over 1985-2000 period. Expenditure variables over 1985-2000 period are instrumented using their mean values over 1970- 1985 period. Exogeneity test cannot be run in the case of 2SLS estimations; (c): Instruments for education expenditures are lagged values of these variables. Only fixed- effects estimations can be run in the case of 2SLS and Hausman test cannot therefore be performed. Fixed country-effects are not reported; * log (y) is used instead of log (y_{70}) in panel-data estimations.

Table 5. Determinants of gross higher education enrolment rate, 1970-2000

Variables	OLS				2SLS							
	Cross-section (a)				Cross-section (b)				Panel-data with fixed-effects (c)			
Constant	15.31	- 2.185	14.29	19.61	12.03	- 5.15	15.45	18.75	- 51.43	- 63.24	- 31.67	- 25.75
	(1.19)	(- 0.14)	(1.38)	(1.74)	(0.63)	(- 0.16)	(1.30)	(1.72)	(- 2.91)	(- 2.25)	(1.69)	(- 0.73)
log (y_{70})*	2.555	2.921	0.569	0.958	3.092	1.479	1.952	2.100	6.908	6.241	5.275	4.227
	(1.30)	(1.77)	(0.28)	(0.50)	(1.59)	(1.57)	(2.12)	(2.22)	(5.29)	(3.58)	(4.23)	(4.02)
GiniEdu	- 0.369	- 0.314	- 0.282	- 0.334	- 0.372	- 0.406	- 0.277	- 0.335	- 0.184	- 0.128	- 0.233	- 0.385
	(- 3.22)	(- 3.11)	(- 3.05)	(- 3.34)	(- 3.12)	(- 2.00)	(- 2.38)	(- 3.52)	(- 2.10)	(- 1.52)	(- 3.70)	(- 2.08)
Gini	- 0.359	- 0.595	- 0.372	- 0.271	- 0.501	- 0.837	- 0.401	- 0.285	- 0.247	- 0.396	- 0.314	- 0.251
	(- 1.90)	(- 2.30)	(- 2.30)	(- 1.67)	(- 2.13)	(- 2.37)	(- 2.07)	(- 1.45)	(- 2.08)	(- 2.37)	(- 1.75)	(- 1.74)
CR	0.120	0.155	0.113	0.105	0.145	0. 139	0.123	0.147	0.124	0.109	0.126	0.145
	(1.25)	(1.49)	(1.18)	(1.08)	(1.93)	(1.83)	(1.73)	(1.94)	(1.65)	(1.90)	(1.95)	(2.02)
τ	1.784				1.740				1.114			
	(1.20)				(1.06)				(1.32)			
log (Exp_{ter})		3.700				6.645				3.309		
		(1.87)				(2.20)				(1.73)		
log (Exp_{sec})			3.221				3.802				3.346	
			(1.58)				(2.80)				(2.02)	
log (Exp_{prim})				2.043				2.252				3.419
				(1.43)				(1.96)				(2.26)
D_1: income or	5.405	8.855	7.961	6.391	7.849	7.541	12.33	12.49	- 1.196	4.200	2.377	- 0.990
expenditure	(1.31)	(2.62)	(1.94)	(1.48)	(1.18)	(0.79)	(2.07)	(1.80)	(- 0.32)	(1.01)	(0.39)	(- 0.15)
D_2: individual or	- 2.817	- 4.046	- 7.415	- 8.162	0.566	3.613	- 7.268	- 6.142	0.521	5.127	- 4.939	- 5.062
household	(- 0.47)	(- 0.69)	(- 1.99)	(- 2.21)	(0.12)	(0.52)	(- 1.94)	(- 1.03)	(0.21)	(1.09)	(- 1.09)	(- 1.02)
D_3: gross	4.774	7.358	4.541	3.905	7.015	12.79	5.498	2.616	3.877	2.906	4.140	4.387
or net	(0.96)	(1.27)	(0.97)	(0.89)	(1.44)	(1.62)	(1.41)	(0.46)	(1.45)	(1.46)	(0.80)	(4.32)
No. observations	69	69	69	69	69	69	69	69	142	138	134	134
R^2	0.641	0.549	0.683	0.672	0.546	0.600	0.604	0.588	0.702	0.767	0.711	0.773

Notes: t-statistics in parenthesis; (a) Average tertiary enrolment ratios are computed over 1970-2000 period. Regressions are run using robust estimations. Breusch-Pagan χ^2(.) equals 6.83, 5.55, 5.45, and 6.65, with Pr > χ^2 equal to 0.02, 0.01, 0.01 and 0.02; (b) Enrolment rates are averaged over 1985-2000 period. Expenditure variables over 1985-2000 period are instrumented using their mean values over 1970- 1985 period. Exogeneity test cannot be run in the case of 2SLS estimations; (c): Instruments for education expenditures are lagged values of these variables. Only fixed- effects estimations can be run in the case of 2SLS and Hausman test cannot therefore be performed. Fixed country-effects are not reported; * log (y) is used instead of log (y_{70}) in panel-data estimations.

Second, the estimations reveal the effectiveness of financing the lower levels of schooling in fostering enrolment rates in the higher stages of education. Indeed, according to Table 6, expenditures at the primary school level are at least as important as those devoted to the secondary level in affecting enrolment rates at the secondary level. Similarly, through their quality effect, per-student expenditures allocated to the primary and secondary levels also exert a significant effect on enrolment rates at the tertiary education level.

Both cross-section and panel-data estimations provide evidence that tertiary-education enrolment ratios are more affected by additional expenditures that are allocated to both primary and secondary levels than by expenditures devoted to the tertiary level. Therefore, the importance of the quality effect associated with the financing of the basic school levels should depress the general belief that expenditures should be biased in favour of higher levels of education in the context of credit-market imperfections. Indeed, the estimations presented above show that countries with low levels of per-student expenditures at the basic school stages also experience lower enrolment ratios at the higher levels of education.

Overall, the results reported in Tables 4 and 5 contrast with the conjecture that public education provisions are not effective in improving school participation. By disaggregating education expenditures, we have shown that public financial resources are important in reducing schooling gaps through both the quality and the liquidity effects. In particular, the quality effect is at least as important as the liquidity effect in enhancing enrolment ratios at the post-primary school levels.

Table 6. The impacts on enrolment ratios of a one standard deviation increase in per-student expenditures at the various school levels, in percentage

	Cross-section estimates		Panel-data estimates	
	Secondary	*Higher*	*Secondary*	*Higher*
log (Exp_{prim})	2.39	2.92	2.25	4.71
log (Exp_{sec})	2.45	3.98	2.83	3.79
log (Exp_{ter})		5.79		2.97

Source: author's calculations from the 2SLS estimations in Tables 4 and 5.

V. Inter-regional comparison of the sources of enrolment gaps

As a final point of our analysis, it is interesting to illustrate the contribution of the variables used in our regressions to the inter-regional variance in school enrolment ratios. To do that, we compare the regional averages of secondary and higher-education enrolments between the Sub-Saharan African countries and Latin America on one hand, and the OECD countries on the other.

Sub-Saharan African and Latin American countries are known to have high income and education inequalities and an inefficient financial system. They are also known for their inefficient educational systems, even though they absorb high levels of public resources. The ratio of public expenditures on education to GDP over the period 1970-2000 was, indeed, 4.41 percent in the Sub-Saharan African countries and 3.98 percent in the Latin American countries, against 4.85 percent in the OECD countries.

The differences in the average enrolment rates between the Sub-Saharan African region and the OECD countries are 64.6 percent at the secondary level and 30.6 percent at the higher-education level. These differences are, respectively, 41.6 percent and 19.6 percent in the Latin American countries and the OECD countries. These gaps are broken down in Table 7, according to the contribution of each of the variables used in this analysis. To explain our approach, let's take the panel-data estimations presented in Tables 4 and 5.

Enrolment rates can be expressed as follows:

$$S_{it} = \alpha + X_{it}\beta + v_i + \varepsilon_{it} \qquad (2)$$

where X_{it} is a matrix of the explanatory variables used in the analysis, v_i is the country-specific residual, and ε_{it} is the "usual" residual with the usual properties.

If we define a region *j* as a group of countries, average enrolment rate in this region is given by

$$\bar{S}_j = \alpha + \bar{X}_j\beta + \bar{v}_j + \bar{\varepsilon}_j , \qquad (3)$$

where $\bar{S}_j = \sum_i^{n_j}\sum_t^{T_j} S_{it} / n_j T_j$, $\bar{X}_j = \sum_i^{n_j}\sum_t^{T_j} X_{it} / n_j T_j$,

$\bar{v}_j = \sum_i^{n_j} v_i / n_j, \bar{\varepsilon}_j = \sum_i^{n_j}\sum_t^{T_j} \varepsilon_{it} / n_j T_j$ and n_j and T_j are respectively the size and time period of the region *j*.

Thus, the difference in average enrolment rates between regions *A* and *B*, can be decomposed as follows:

$$\bar{S}_A - \bar{S}_B = \left(\bar{X}_A - \bar{X}_B\right)\beta + \left(\bar{v}_A - \bar{v}_B\right) + \left(\bar{\varepsilon}_A - \bar{\varepsilon}_B\right) \quad (4)$$

The first term in the right-side of this equality expresses the contribution of the observed variables in explaining the enrolment difference, while the second and third terms refer to the contribution of the unobserved factors in the enrolment gap.

It is interesting to underline that the results reported in Table 7 rely on the arithmetic mean of the estimated coefficients shown in Tables 4 and 5. One advantage of this procedure is to take into account the contributions of all types of expenditures in explaining schooling gaps at each educational level, introduced separately in Tables 5 and 6 because of problems of multicollinearity.

Controlling for the degree of economic development, inequality in education and incomes and the extent of borrowing-constraints are the important sources of the observed gaps in secondary and higher-education enrolment rates between the Sub-Saharan and Latin American countries on one hand, and OECD countries on the other. They account for around 75 percent and 55 percent of the secondary and tertiary school gaps, respectively. The results in Table 7 reveal another important fact. The joined contribution of financial factors (*Gini* and *CR*) to the inter-regional differentials in enrolment rates is —in most of cases— larger than the contribution of educational inequality. That is, high income inequality associated with underdeveloped financial markets in the Sub-Saharan and Latin American countries can explain between 30 percent and 50 percent of the gaps in secondary and higher-education enrolments, vis-à-vis the OECD countries. Education inequality in these regions accounts for 20 percent to around 40 percent of these gaps.

Education provisions exert a less important effect on these gaps, with a contribution of less than 4 percent in the case of the Sub-Saharan countries/OECD comparison and 11 percent in the case of Latin American countries/OECD comparison. The disaggregation of total expenditures into expenditures devoted to the various school levels confirms, once again, the importance of financing the lower-school levels in closing enrolment gaps at the higher levels. This is evident

Table 7. Sources of inter-regional differences in average enrolment rates, 1970-2000

Variables	Sub-Saharan Africa / OECD		Latin America / OECD	
	Point difference	Percent difference	Point difference	Percent difference
Secondary school enrolment ratios				
Per-capita income	- 15.65	24.21	- 7.58	18.19
GiniEdu	- 24.47	37.86	- 10.91	26.18
Gini *	- 18.08	27.97	- 18.90	45.36
CR	- 4.63	7.16	- 2.21	5.30
Public expenditures τ	- 0.93	1.43	- 1.65	3.96
log (Exp_{prim})	- 0.57	0.88	- 0.48	1.15
log (Exp_{sec})	- 0.36	0.55	- 1.17	2.81
Difference estimated	- 63.76	98.63	- 41.25	99.01
Difference observed	- 64.63	100	- 41.66	100
Difference unexplained	- 0.87	1.37	- 0.41	0.99
Higher education enrolment ratios				
Per-capita income	- 10.44	34.08	- 5.08	25.87
GiniEdu	- 7.06	23.04	- 3.78	19.25
Gini *	- 5.86	19.13	- 5.98	30.46
CR	- 3.47	11.32	- 2.06	9.52
Public expenditures τ	- 1.18	3.85	- 2.28	11.61
log (Exp_{prim})	- 0.80	2.61	- 0.65	3.31
log (Exp_{sec})	- 0.32	1.04	- 1.03	5.24
log (Exp_{ter})	- 0.06	0.20	- 0.60	3.05
Difference estimated	- 28.01	91.44	- 19.18	97.70
Difference observed	- 30.63	100	- 19.63	100
Difference unexplained	- 2.62	8.56	- 0.45	2.30

Notes: the results in this table rely on the arithmetic mean of the estimated coefficients using fixed effects-panel data presented in Tables 5 and 6; * definitional dummies are taken into account in the calculation of the difference of enrolments associated with the difference in the Gini of incomes.

especially in the case of the Sub-Saharan African region, where the differential in primary expenditures contributes more than the differential in secondary expenditures to the gap in the secondary school enrolment, vis-à-vis the OECD countries. Similarly, the gap in the tertiary-education enrolment rate would be mitigated if more expenditures were devoted to the primary and the secondary levels than to the tertiary level, in the case of both African and Latin American countries.

Finally, our explanatory variables capture most of the observed inter-regional enrolment gaps. The remainder, shown in the line “difference unexplained”, is attributed to the unobserved residuals; namely, the specific country-effects.

VI. Conclusion

We tested in this study the strength of the credit-constraints thesis in schooling using international data. We confront our regression results with other empirical studies that use American data and find no significant role of credit-constraints in explaining American schooling-attendance gaps. Our regression results present several pieces of evidence that support the importance of credit-constraints in producing cross-country schooling gaps.

First, controlling for the effects of per-capita income and education inequality, we find that enrolment ratios in both secondary and higher-educational levels are negatively correlated with the Gini index of income and positively correlated with the degree of financial development. Second, these correlations are robust to the specific-country effects, the sample composition, and the inclusion of public education expenditures. Finally, public education expenditures are an important determinant of the variance of school enrolments in both the secondary and the tertiary levels.

Distinguishing poor from wealthy countries can show a crucial fact: the marginal effects of both social and material factors are higher in wealthy countries than in poor ones. This result implies that more equal income distribution and greater accessibility to the credit market are likely to be more effective in fostering enrolment ratios in the developed countries than in the developing ones.

Finally, we find that school enrolment ratios are affected not only by the expenditures directly allocated to the relevant levels but also by those allocated to the previous ones. Therefore, countries that allocate low levels of expenditures to the lower-school stages also experience a drop in school enrolment rates at the higher stages.

The inter-regional comparison exercise shows that inequalities in incomes and education, as well as the extent of the credit-constraints and public education expenditures, together capture at least 65 percent of the tertiary-education enrolment gap between the Sub-Saharan African region and the OECD countries, and 70 percent of this gap between the Latin American countries and the OECD. At the secondary level, these variables account for 75 percent to 80 percent of the inter-regional gaps in the enrolment ratios.

Appendix

A. Data

Table A1. Regional averages for the years 1970 and 2000

Country	GDP per capita	Secondary enrolment	Tertiary enrolment	*Gini**	*GiniEdu*	*CR***	τ	Exp_{prim}	Exp_{sec}	Exp_{ter}
DCs										
- 1970	1020	20.7	4.1	41.8	58.3	13.9	3.3	120	321	1771
- 2000	4770	53.9	15	41.4	45.8	26.1	4.2	855	1403	3949
Sub-saharan Africa										
- 1970	444	7.0	0.8	45.3	67.4	12.2	3.3	56	227	860
- 2000	2570	29.3	3.6	44	58.6	17.6	4.4	164	819	2553
Latin America										
- 1970	804	23.8	4.9	38.7	50.8	18.5	3.2	72	144	916
- 2000	5019	53.4	18.9	48.5	42.8	28.1	3.6	612	872	4761
OECD***										
- 1970	3398	59.8	14.7	33.7	28.5	34.2	4.7	855	1026	2726
- 2000	17660	110.4	49.6	32.1	29.9	62.6	5.9	3390	5665	10230

Notes: GDP per capita is in $ PPP; secondary and tertiary enrolment refer to the gross enrolment ratios; *Gini* and *GiniEdu* are the Gini indexes of incomes and education respectively; *CR* is the credits to GDP ratio; τ is the ratio of public education expenditures to GDP; Exp_{prim}, Exp_{sec}, and Exp_{ter} are primary, secondary, and tertiary per-student expenditures in $ PPP; * data for 1970 refer to the closest year to 1970, data for 2000 to the closest year to 2000; ** data for 2000 refer to 1999; *** as in 1970, Mexico. Korea. Hungary. and Slovak Republic are not considered in the OECD group in 2000.

Table A2. Summary descriptive statistics for the year 2000 in DCs and in OECD countries[***]

Country	GDP per capita	Secondary enrolment	Tertiary enrolment	Gini[*]	GiniEdu	CR[**]	τ	Exp_{prim}	Exp_{sec}	Exp_{ter}
Algeria	4325	61.5	11.3		59.9	42.1				
Bahamas		91.4	24.2	48.4		31.2				
Bangladesh	1289	21	5.5	39	73.3	5.4	1.5	286	845	1323
Barbados	12680	86	28.6		30	38		546	678	6454
Belarus	6256	91.6	42.6							
Bolivia	2357	37.8	23.2		53.6	5.2				
Botswana	5489	55	4.9		52.3	19.5	3.3	420	880	3898
Brazil	6039	42.8	11.2	58	39.2	18	4.6	955	1105	13565
Bulgaria	6421	73.3	33.9	21.5	21.2	5.8	3.5	2210	1990	2980
Chile	7040	69.2	25.5	46	31.3	7.9	2.8	1700	1940	6930
China	2260	58.8	3.9	37.8	42.2	86.1	1.9	375	835	5465
Colombia	4830	57.1	16.4	52	48.6	11.4	2.4	610	806	5232
Costa Rica	4916	45.5	30.8	44	42.5	17.6	5.8	1340	1308	5775
Cote d'Ivoire	1857	22.9	4	38		17.7	4.6	151	556	2151
Dominican Rep.	3217	38.6	21.4	43.3		13.4	1.8	456	590	3560
Ecuador	3538	52.3	21.2		44.8	13.7	2.8	352	691	2330
Egypt	3330	75.7	17.7		62.1	17.8	4.9	320	960	2350
El Salvador	3560	29.6	15.8			24.2		286	326	3248
Estonia	6661	97.5	27.3							
Gabon	7796					9.7				
Ghana	1181	36.4	1.4			1.6	2.7			
Guatemala	3468	24.8	7.9		62.5	11.1		260	1255	1629
Honduras	1968	32.6	9.6	59	46.8	18.3	3.5	238	183	1098
Hungary	7985	90.4	18.4	24	21.1	17.5	4.6	2100	2370	5865
India	1709	48.2	5.9	29.7	68.6	25.8	2.9	884	1193	3932
Indonesia	3116			31.7	40.7	19.3		15	80	1450
Jamaica	3411	65	6.6	43	32.9	23.7	4.6	254	450	2608
Jordan	3547	38	2	40.8	75.6				1007	

Table A2. (Continued) Summary descriptive statistics for the year 2000 in DCs and in OECD countries[***]

Country	GDP per capita	Secondary enrolment	Tertiary enrolment	Gini[*]	GiniEdu	CR[**]	τ	Exp_{prim}	Exp_{sec}	Exp_{ter}
Kazakhstan	5757	90.8	35.6							
Kenya	1143	26	1.5	55	51.5	19.5	4.1	35	120	1230
Korea Rep.	11514	94.8	45.6	33	21.8	31.2	3.4	3514	4725	4374
Latvia	6498	87	23.5					1062	871	
Lesotho	1180	27.4	2.1		64.1	12.9	11.3	38	149	2238
Lithuania	6341	83.6	27.9							
Madagascar	778	16	2.7			18.5				
Malaysia	7012				42.1	9.9	3.6	234	556	3993
Mauritania	1272	14.9	3.6			29.8			942	2519
Mauritius	9853	58.5	5.5	46	43.8	22.2	3.5	245	546	3540
Mexico	7128	56.4	14.2	50	38.3	8.1	4.4	1130	1480	5320
Morocco	3338					14.9		149	331	3546
Nepal	1109	36.6	5.2	31		14.1	3.3	560	1560	2400
Nicaragua	1746	41.5	10.2		58.7	19			1198	4410
Niger	809	6.5	0.7			17.1		181	114	
Nigera	786	29.8	4.1	37		16.3				
Pakitsan	1714	26	3.2	32	64.4	20.5	3.6	156	942	2492
Panama	5198	65.2	26.6		33.9	45.2		107	239	3879
Peru	3723	67.4	31.4	43	43.1	3.8	2.8	485	580	2001
Philippines	2752	76.8	27.3	51.3	32.8	15.7	2.6	475	405	1230
Poland	6202	92.8	24.6	26	14.1	2.5	4.9	276	232	1530
Rwanda	817	10.7	0.5		66.1	5.7	2.1	55	230	2995
Senegal	1330	16.2	3.4		69.7	29.1	3.9			
Sierra Leone	945	18	1.4			5.4				
Singapore	19415	67	26.7	40.7	44	58.3	2.3	3640	5800	9300
Slovak Rep.	9010	90.1	17.7					1427	2130	5555
Slovenia	10959	90.8	29.8			20.7				
South Africa	6903	86.1	14.9			46.9			4009	3080

Table A2. (Continued) Summary descriptive statistics for the year 2000 in DCs and in OECD countries[***]

Country	GDP per capita	Secondary enrolment	Tertiary enrolment	Gini*	GiniEdu	CR**	τ	Exp_{prim}	Exp_{sec}	Exp_{ter}
Sri Lanka	2633	74.6	4.7		28.8	6.9				
Sudan		19.3	4		75.2	10.9				2512
Taiwan	12457		17.9	31.2		35.5		3540	5472	6355
Thailand	5539	42.8	18.9	48	39.1		3.2	730	1260	3230
Trinidad & Tobago	9010	76	7.4	51	31.2	13.9		550	778	2995
Tunisia	4959	53	11.4	40	61.6	51.3	5.6	950	1290	5010
Uganda	677	11.8	1.5							
Venezuela	6507	34.9	27.2	44	47.2	16.6	4.2	530	790	9890
Yugoslavia										
Zambia	878	26.3	2.4		46.8		1.9	45	110	1226
Zimbabwe	2558	47	5.9			15.9	6.5	303	641	2688
Australia	19689	114.5	57.6	41.7	20.6	46.1	4.1	4858	6860	11750
Belgium	19362	134	49.8		29.2	15.3	6.4	3952	6444	9725
Canada	20601	103.9	91.8	31.6	10.1	27.3		4343	5764	14980
Denmark	21125	115.4	43.1	27.5	26.2	42.9	4.1	6720	7630	10660
Finland	17075	117.8	62.4	26	27.5	70.9	6.9	4100	5886	8089
France	18759	107.1	48	44	35.3	29.3	5.5	4100	7150	7860
Greece	11402	94.6	36.8	37	27.1	26.5	4.9	2304	2900	4305
Ireland	14714	111.7	35.7	39	26	4.9		3020	4385	9675
Italy	18647	89.8	37.8	39			4.1	5231	6520	7551
Japan	21874	98.8	38.6	33	24.5	82.4	3.6	5210	6040	10300
Luxembourg	29391					58.1	3.9			
Netherlands	19166	132.1	46.5	29	25.2	87	5	4200	5674	12256
New Zealand	15251	101.5	54.6	36	24.5	77.2	5.3	3867	4130	9368
Norway	20943	114.9	52.8	38		35.5	7.3	5920	7630	12050
Portugal	12144	95.1	32.5	41	43.1	56.6	4.8	3480	5230	4810
Spain	14172	115	43.8	25.9	36.4	63.3	4.4	3650	4870	5770
Sweden	18987	121.6	40.1			39.5	7.8	5730	5920	14220
United Kingdom	17618	122.6	42.9	24.3		18.3	5.3	3676	5610	9760
United States	25596	97	81	34	14.3	51.1	5.2	6590	8160	19220

Notes: GDP per capita is in $ PPP; secondary and tertiary enrolment refer to the gross enrolment ratios; *Gini* and *GiniEdu* are the Gini indexes of incomes and education respectively; *CR* is the credits to GDP ratio; τ is the ratio of public education expenditures to GDP; Exp_{prim}, Exp_{sec}, and Exp_{ter} are primary, secondary, and tertiary per-student expenditures in $ PPP; * data refer to the closest year to 2000; ** data refer to 1999; *** Mexico, Korea, Hungary, and the Slovak Republic are not considered in the OECD group.

B. Computation of the Gini index of education

This index is computed using data on the distribution of the population aged more than 25 years across the school levels, from Barro and Lee (2000) data-set. The following formula was employed:

$$GiniEduc = \frac{1}{2H} \sum_{i}^{n} \sum_{j}^{n} p_i \, p_j \left| x_i - x_j \right| ,$$

where: H is mean years of education of the population; p_i and p_j are the proportions of population with respectively the levels i and j of education; n is the number of educational levels. Barro and Lee define 7 levels: no education, incomplete primary, complete primary, incomplete secondary, complete secondary, incomplete tertiary, and complete tertiary; x_i and x_j are the duration of education at the levels i and j. For simplicity of computations, we have assumed that 5 years are necessary to complete one stage of education, and that incomplete education accounts for 2.5 years.

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